PD-ABG-791
84599

DEVELOPMENT OF A VITAMIN A-RICH WEANING FOOD AND CHILD CEREAL FROM DRIED AND "INSTANTIZED" SWEET POTATO BUDS (SPB II)

Third Quarterly Report
July - September, 1993

Further Studies on Production, Product Quality and Patterns of Utilization in Rural Communities

Submitted to:

Vitamin A Field Support Project (VITAL)
International Science and Technology Institute, Inc.
1616 North Fort Myer Drive, Suite 1240
Arlington, VA 22209

Task No.: 3015-176

Contract Period: January 1 - December 31, 1993

Submitted By:

CeSSIAM-Guatemala
Noel Solomons, M.D., Scientific Coordinator
Jesus Bulux, M.D., MPH, Chief, Vitamin A and Micronutrients

IEF-Bethesda
John Barrows, MPH, Director of Programs
Laine Isaacson, Program Officer

SEPTEMBER 1993

○ ACRONYMS AND ABBREVIATIONS ○

CeSSIAM	Center for Studies of Sensory Impairment, Aging and Metabolism
ICTA	Instituto de Ciencia y Tecnología Agrícola (Institute of Agriculture Science and Technology)
IEF	International Eye Foundation
FIO	Fundacion Internacional del Ojo
NCSU	North Carolina State University
PROVITA	Increasing the Availability of Dietary Vitamin A to Under-Six-Year-Olds Through Natural, Plant Food-Sources of Provitamin A
SPB	Sweet Potato Buds
USAID	United States Agency for International Development
VITAL	Vitamin A Field Support Project
ISTI	International Science and Technology Institute
SUSTAIN	Sharing United States Technology to Aid in the Development of Nutrition
IVACG	International Vitamin A Consultative Group

TABLE OF CONTENTS

I. INTRODUCTION 2

II. INDUSTRIAL PRODUCTION OF SWEET POTATO BUDS. 3

II. TRANSPORTATION OF SAMPLES OF SPB TO NCSU FOR THE PRESERVATION STUDIES. 5

III. FIELD ACTIVITIES. 6
1. Baseline census and planning of product distribution 6
2. Initiation of SPB distribution in the four experimental communities 7
3. Dietary evaluation. 7

IV. COORDINATION AMONG THE PARTICIPATING ENTITIES 8
A. Interaction of CeSSIAM with Malher 8
B. Interaction of CeSSIAM with IEF 9
C. Interaction of IEF with NCSU 9
D. Interaction of IEF with SUSTAIN Program 9

V. FINANCIAL ARRANGEMENTS AND TRANSFERS 10

VI. APPENDICES 10

I. INTRODUCTION

The project, *Development of a Vitamin - A Rich Weaning Food and Child Cereal from Dried and "Instantized" Sweet Potato Buds - Further Studies on Production, Product Quality and Patterns of Utilization in Rural Communities (SPB II)* is a follow-up and extension of the previous IEF Sweet Potato Bud project (SPB I). Financing for both projects is provided through subcontracts to the International Eye Foundation of Bethesda, Maryland from the Vitamin A Field Support Project (VITAL).

This report covers the third quarter (July - September, 1993) of activities conducted by the various participating entities. The primary purpose of the current project is designed to resolve issues left pending from the former experience including: 1) gaining greater technical and industrial experience in the processing of large quantities of sweet potato into the dried, instantized 'bud' product; 2) resolving the preservation of vitamin A activity in SPBs and packaging options; 3) moving, at the community level, from a single exposure to the food product, to a day-to-day availability in order to assess the behavioral aspects of intrahousehold and individual family decisions and levels of economic sacrifice, as well as the culinary diversity exhibited in the preparation of recipes using sweet potato buds in meals.

During this reporting period, the following activities were initiated or completed: a) production of sweet potato buds by Malher Sucesores & Cia. Ltda., b) transfer of samples to North Carolina State University (NCSU) for the preservation studies, c) initiation of distribution of the product to the four experimental communities, d) dietary and behavioral evaluation at the household and community level, e) other activities included the interactions/coordination among participant and collaborative entities.

II. INDUSTRIAL PRODUCTION OF SWEET POTATO BUDS.

In a meeting held at the Malher Sucesores & Cia. Ltda., offices reported during the previous quarterly report, July 11th was the date established for the delivery of fresh sweet potato to the factory, and July 12th was the date established to produce the sweet potato bud product (SPB).

Coordination among the CeSSIAM staff (Ms. Leche, Ms. Arévalo and Dr. Bulux), the Malher representatives (Ing. García and Ing. Barrios), and the provider (Mr. Barrientos) intensified in the first week of July in order to guarantee the harvesting and transportation of fresh sweet potato to the factory and to document and supervise the production of SPB.

Harvesting of sweet potato from the field was performed from July 7th through July 10th. The product was packed in bags of polypropylene plastic and transported to the Malher factory located at 50 Km from Guatemala City, in El Tejar, Chimaltenango on Sunday, July 11th. All of the raw product came from the fields of San Miguel Dueñas in the Department of Sacatepéquez. A total of 388 quintales (38,800 lbs) were received in the factory.

On Monday, July 12th under the authorization of the General Manager of Malher, Sucesores & Cia. Ltda., Mr. Carlos Maldonado, the CeSSIAM staff (Ms. Leche, Ms. Arévalo, and Dr. Bulux) went to the site of production and entered the factory at 8:00 a.m. Ing. García (Production Manager), Ing. Barrios (Factory Manager), and Mr. Víctor Hugo Arana (Production Boss) were all present during the process of production. Mr. Arana, was in charge of explaining the production process and to help CeSSIAM staff document all production steps. A brief description of the process follows (see photographs in Appendix 2):

1. Three-hundred and eighty-eight quintales (38,800 lbs) of fresh sweet potatoes were provided by Mr. Barrientos the day prior to production and were stored in an cool, dry, dark-room. The room has a high storage capacity since the production system is capable of processing up to 1,200 quintales (120,000 lbs) per day. The machinery has a minimum capacity of 200 quintales (20,000 lbs) per run.

2. Preheating of the caldrons began at 6:00 pm the day before production.

3. Beginning at 6:00 am, the sweet potato enters the production line in the same condition as it was delivered from the field; the first step is the washing of the potato in an agitating cylinder under high water pressure. This process removes excess soil from the outer husk of the entire potato.

4. After cleaning, the potatoes continues on a conveyer to a deposit.

5. Approximately, 100 lbs of sweet potato from the deposit are transferred to a gyrating cast-iron caldron. The purpose is to expose the sweet potatoes to a 45 second thermal shock (approximately 115°C) with live steam. The effect of this step on the sweet potato is to soften the husk and efficiently prepare it for the next step which is peeling. Live steam penetrates less than a 1/4 inch into the potato.

6. From the caldron, the potato is deposited onto another conveyer which carries the sweet potato to a peeling chamber, a gyrating cylinder with the interior surrounded by hard cylindrical brushes. The "first grade burned" husk, almost entirely removed during step #5, is totally removed. The peeled potato is given a final cleaning by a stream of water.

7. The peeled potato is transported on another conveyer to a selection table. Here the product undergoes a final peeling by hand since irregularities still may have some husk. The largest potatoes are also cut in order to ensure a uniform size and of the potato is transported to another conveyer which carries the potato to a holding tank.

8. The potato is kept in a holding tank with cold water and the antioxidant BHT (0.06% concentration). The purpose of the holding tank is to control the flow of the product to the mill and prevent oxidation.

9. A "never-ending screw" transports sweet potato to the mill in which slices of about 1/4 inch thick are obtained. Slices are always receiving a bath of cold water in order to wash off activated starch (gelatin) and more BHT is manually added to prevent further oxidation.

10. Slices are transported to a pre-cooking chamber where they are cooked with live steam (70°C) for 40 minutes.

11. Another "never-ending screw" transports the precooked product to a cooling tank. The purpose is to preserve the organoleptic properties and prevent further gelatinization. The already activated starch (sponging) is removed. The product is kept in this tank for about 40 minutes.

12. A hydro-pneumatic conveyer transports the cold, cooked slices to a final cooking tank. The product is again exposed to live steam in the water-sealed tank for about 45 minutes.

13. The product is then forced through a screen to macerate the potato and obtain a semisolid dough.

14. The puree falls onto drying cylinders to be exposed to a steam drying process under pressure (80 psi) in a closed chamber where humidity is extracted. Dehydration of the product occurs in about 15 seconds. (Steam is recycled to the pre-heating caldrons). While the product is rotating between cylinders it becomes dehydrated and thin. A final

large sheet of dry product (resembling a huge sheet of paper of about 0.0006" in thickness) is obtained. Operators take care of the homogenization of the product on the cylinders in order to avoid prolonged exposure to the drying process and avoid carmelization of sugars and aminoacids (Maillard reaction).

15. From the drying cylinders, the final sheet is broken up by an operator and where it falls down onto another spiral conveyer which transports it to a selection conveyer-belt. While in transportation the product is broken up into smaller flakes.

16. Once on the selection conveyer-belt, operators separate foreign material such as bits of husk, caramelized pieces, or bits not sufficiently dried.

17. A spiral conveyer transports the selected product to a wire-mesh mill to be ground into the desired uniform small size of buds.

18. Buds are allowed to cool for a period of about two hours and then they are packed into opaque double polyethylene plastic bags.

19. Calculations made by the producers indicated a yield of 13% of the original weight of the fresh sweet potato.

II. TRANSPORTATION OF SAMPLES OF SPB TO NCSU FOR THE PRESERVATION STUDIES.

The second project objective is to perform studies on the stability of the provitamin A present in processed SPB. Further observations include assessing preservation of ß-carotene in diverse packaging material, with diverse preservatives, and the effect of adding other micronutrients to the flakes of SPB. This portion of the project is undertaken by Dr. Steve Schwartz, at the Department of Food Science, North Carolina State University. Dr. Carmen Yolanda López (who participated in previous studies in Dr. Schwartz's laboratory) was in charge of the transportation of the freshly produced SPB to NCSU.

After the cooling period of the SPB from the production line at the Malher factory, approximately 50 lbs were immediately packed into individual one-pound opaque plastic bags and sealed. These individual bags were then packed into two 25-lbs dark paper-plastic bags.

The product was transported to CeSSIAM and prepared for transportation. On Tuesday, July 13th, Dr. López traveled to NCSU and transported the product directly to Dr. Schwartz' lab. Although not previously planned, samples of the fresh sweet potato used in this production for chemical analysis were included. Upon arrival to NCSU, the fresh sweet potato was prepared for storage by blanching and freezing.

Appendix 3 shows the report sent by Dr. Schwartz to Mr. John Barrows (IEF) informing IEF of progress made in the analyses. In brief, upon arrival, antioxidants and micronutrients were added to fresh buds. Four different packaging environments were used (oxygen permeable, barrier pack with air, barrier pack with air and oxygen scavenger, barrier pack with vacuum).

Analysis of fresh sweet potato showed that the variety used in this process contained lesser amounts of ß-carotene (16.5 μg/g fresh wt.) than those used in the previous project. As a result, the content of fresh sweet potato buds also contained less provitamin A (42.2 μg/g bud) than the last year's production (57.5 μg/g bud). As scheduled, (Appendix 3) time 0 and time 1 analyses at NCSU were performed.

III. FIELD ACTIVITIES.

1. Baseline census and planning of product distribution.

These tasks are under the responsibility of Ms. Leche and Ms. Arevalo under the supervision of Dr. Bulux. In the second quarterly report we informed that the baseline census was completed for the communities of the Department of Guatemala (Santa Barbara, and Lo de Rodríguez). A census was completed in the remaining two communities located in the Department of Sacatepequez (La Libertad, and Santa Isabel) during the first weeks of July. The final census had the following results:

Santa Barbara	58 families
Lo de Rodríguez	60 families
Santa Isabel	32 families
La Libertad	41 families

Census data were entered in a computer database.

Research in the local community markets of the different prices for products similar to SPB was undertaken. Four quetzales (Q4 = 73c) was determined by the team to be a competitive price for SPB (considering that this would be the monetary sacrifice made by the population to acquire similar products such as Incaparina, Cereals, etc.)

The distribution format was randomly assigned to each of the four communities by means of four cards with the different formats on them selected randomly for each community. Results were the following:

* Santa Barbara (coded as community 4) was assigned to format 1 (100% price, daily availability).

* Lo de Rodríguez (coded as community 3) was assigned to format 2 (50% price, daily availability).

* La Libertad (coded as community 1) was assigned to format 4 (unlimited quantity available free once a week).

* Santa Isabel (coded as community 2) was assigned to format 3 (limited quantity of one pound per preschool-age child, available free once a week).

SPB storage and distribution facilities were also investigated in the communities. The final results were: three distribution centers for each of the communities of Santa Barbara and Lo de Rodríguez; and, a storage facility for each of the four communities. In Santa Isabel and La Libertad the storage facilities are distribution sites as well.

2. Initiation of SPB distribution in the four experimental communities.

Distribution in Santa Bárbara and Lo de Rodríguez was initiated on August 6th and 9th, respectively. This delay was due to the fact that distribution could not start before the dietary evaluation was finished and promotion of the product was started. In these two communities promotion is made by invitation of the enrolled mothers to attend demonstration meetings at one of the storage sites and learn about the product as well as the different culinary possibilities. Mothers who do not attend the meetings are visited at home.

Distribution in Santa Isabel and La Libertad started on August 24th and 26th, respectively, after the dietary evaluation was completed. One day of the week is dedicated to distribution of the product according to the assigned format. Demonstrations about the possibilities of usage of the product are performed the same day of distribution.

As expected, preliminary data indicates that the product is well accepted and demanded by the mothers of the communities with the free format (see Appendix 4), while in the 50% price format demand is less and in the 100% price format demand is almost non-existent (only 22 lbs sold after 5 weeks of promotion and availability).

In Santa Isabel and La Libertad, some creative recipes were presented by the users. In addition to the suggested gruel and puree, other recipes were developed such as soups, pancakes, different kinds of breads, etc. (Appendix 5, shows some of the recipes developed in the community and recorded by our staff).

3. Dietary evaluation.

This task is under the responsibility of Lic. Gamero and Dr. Valdez, under the supervision of Dr. Bulux. Data entry is under the responsibility of Lic. Romero. (Appendix 6) Initial contacts with the communities were made together with Ms. Leche. Community leaders were contacted to explain the project.

After the methods of data collection were standardized, instruments and procedures were finalized for use in the communities. Maps of the communities were also developed by the census staff for use in monitoring distribution.

Data were collected from each child under-six-years old identified in the baseline census. Data collection instruments included a food-frequency questionnaire (Appendix 7) containing a list of vitamin A-rich foods, and a 24-hr recall form (Appendix 8). In addition to the forms, samples of the serving instruments (dishes, spoons, cups, glasses, etc.) of common use in the communities were collected and measured, in order to get accurate information about quantities of foods consumed and recorded in the forms. Baseline dietary evaluation started on July 6th in Santa Barbara and finished on August 12th in La Libertad.

The review, organization and cleaning of data took place at CeSSIAM. A program for data entry was developed by Dr. Bulux. The process of data entry has been the responsibility of Lic. Eugenia Romero. The process of entry of the data collected through the food-frequency questionnaire is completed. However, data cleaning, coding and entry of the information collected in the 24-hr instrument, which is more elaborate, is not completed.

The follow-up dietary evaluation began on September 6th in Santa Barbara (one month after the distribution started in that community). The other communities will be completed according to the schedule of distribution time. During this period, the data collected are only through the application of the food-frequency instrument. While dietary evaluation is undergoing, data forms are coded and reviewed. If abnormalities are detected, Lic. Romero asks the team to correct the information or, if necessary, re-interview the subject.

IV. COORDINATION AMONG THE PARTICIPATING ENTITIES

During the quarter, there were a series of interactions among the participating entities.

A. Interaction of CeSSIAM with Malher

The interactions and coordination in Guatemala between CeSSIAM and Malher Sucesores & Cia. Ltda intensified during the period. Harvesting and processing of the SPB was completed.

During the week of August 23rd, Dr. Bulux attended the III Regional Workshop on Vitamin A and other micronutrients deficiencies, held in Recife, Brazil and supported by VITAL and other regional and local institutions.

B. Interaction of CeSSIAM with IEF

Continuous communication with Mr. John Barrows was maintained regarding the field activities, the procurement process, shipment of SPBs to NCSU, and the transfer of funds from Bethesda to Guatemala.

Mr. John Barrows, Director of Programs, was in Guatemala from July 1st - 4th, 1993 for a site visit and was able to discuss progress of the project with CeSSIAM staff.

C. Interaction of IEF with NCSU

The formal arrangements for the sub-contract for the food science and food technology components of the study to be performed in the Department of Food Science of the North Carolina State University was finalized during the reporting period.

Communication was made on a regular basis with NCSU to coordinate shipment of the SPBs and for review of progress made in the laboratory analysis of SPBs.

D. Interaction of IEF with SUSTAIN Program

Liz Turner, Program Director and Ellen Quinn, Assistant Director, of Sharing United States Technology to Aid in the Improvement of Nutrition (SUSTAIN Program) were contacted concerning technical assistance needs. Arrangements for a SUSTAIN consultant, Terry Volpe, PhD. of the Nabisco Company to visit CeSSIAM and Malher Sucesores & Cia. Ltda., in mid-August were finalized.

On August 19th, Dr. Terry Volpe, on behalf of the SUSTAIN program, visited CeSSIAM and met with Dr. Carlos Valdez, Lic. Hector Gamero and Dr. Jesus Bulux. The nature of the project was explained to her and details of the implementation were provided. A discussion on the marketing process was undertaken with the team.

On August 23rd, Dr. Volpe visited the Malher Company office in zone 12, Guatemala City. Dr Volpe was received by Mr. Carlos Maldonado, General Manager and Mr. César García, Production Manager. A productive discussion was held in the Malher offices regarding the packaging process, ways to reduce costs of production, and the mechanisms of obtaining support from SUSTAIN. Malher showed interest in the SPB commercialization as a social contribution to the country of Guatemala for the control of vitamin A deficiency. Malher officials are keenly interested in the results of the ongoing field pricing assessments and in the preservation studies ongoing at NCSU.

A briefing by Dr. Volpe on the visit was made on September 27th, at the SUSTAIN Project office in Washington, D.C.. Ms. Laine Isaacson of IEF, attended the briefing in the place of Mr. John Barrows who was absent from Bethesda that day.

V. FINANCIAL ARRANGEMENTS AND TRANSFERS

Transfer of funds from Bethesda to Guatemala continue on a routine basis. The receipts and financial statement from CeSSIAM for the first five months (January - May, 1993) were received in the Bethesda offices of IEF and were process and sent to VITAL for reimbursement in June.

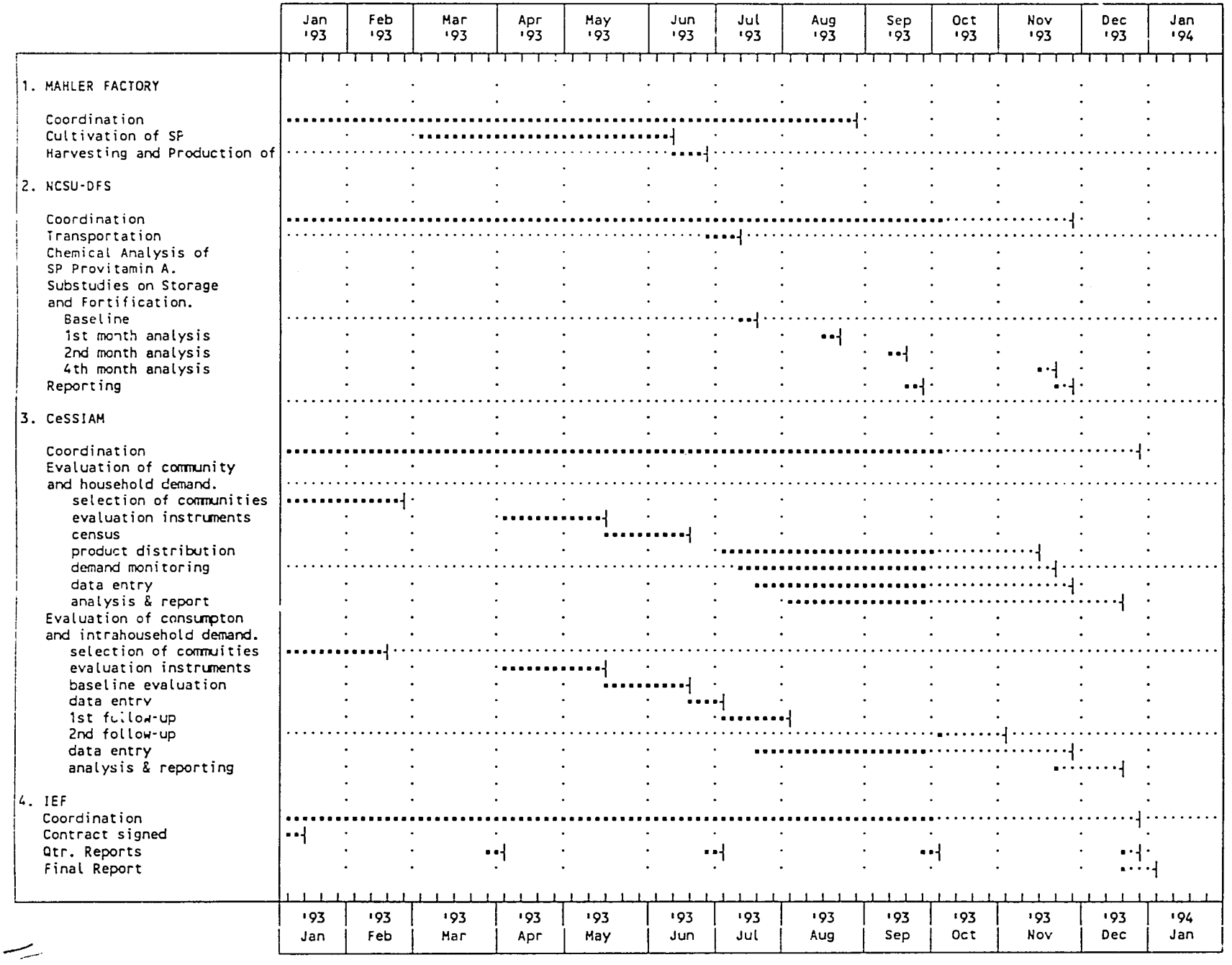
The addition of a fifth field person, Lic. Eugenia Romero, to work part-time for three months with the purpose to enter data, was requested of VITAL. (See previous report for purpose of the position). Although, the inclusion of Lic. Romero does not exceed the total sub-contract budget, IEF was informed by VITAL in September of a potential problem in the sub-contract agreement regarding personnel and total man hours designated. This issue is still outstanding.

VI. APPENDICES

Appendix 1. Gantt Diagram of Revised Calendar of Activities
Appendix 2. Photographs
Appendix 3. NCSU Report and Project Outline
Appendix 4. Census and Distribution Report
Appendix 5. Recipes
Appendix 6. Dietary Evaluation H. Gamero and Valdez
Appendix 7. Food-frequency Questionnaire
Appendix 8. 24-hr recall

September 30, 1993

CALENDAR OF ACTIVITIES: PROJECT SWEET POTATO BUDS II
MARCH - DECEMBER, 1993



Appendix 1

Appendix 2, Photographs

First Page

Photograph #1 Step #1 Workers handling raw sweet potato from the field to production line.	Photograph #2 Step #3 Washing process in agitating cylinder.
Photograph #3 Step #5 Sweet potato transferred to gyrating caldron for 45 second thermal shock with live steam.	Photograph #4 Step #7 After passing through peeling chamber, sweet potato passes along selection table for final peeling and cutting.

Second Page

Photograph #5 Step #9 Sweet potato pass through mill and are sliced to 1/4 inch thick pieces.	Photograph #6 Step #10 Slices are transported to pre-cooking chamber and cooked with live steam for 40 minutes.
Photograph #7 Step #14 After maceration, the puree undergoes steam drying process under pressure in closed chamber.	Photograph #8 Step #15 From the drying cylinders, the large sheet (0.0006" in thickness) is broken up.

Third Page

Photograph #9 Step #16 On the selection conveyer belt, foreign material and caramelized pieces are removed.	Photograph #10 Step #18 SPBs are cooled and packed.
Photograph #11 Preparation of SPB samples for transportation to NCSU.	Photograph #12 View of factory, Malher officials, and CeSSIAM staff.

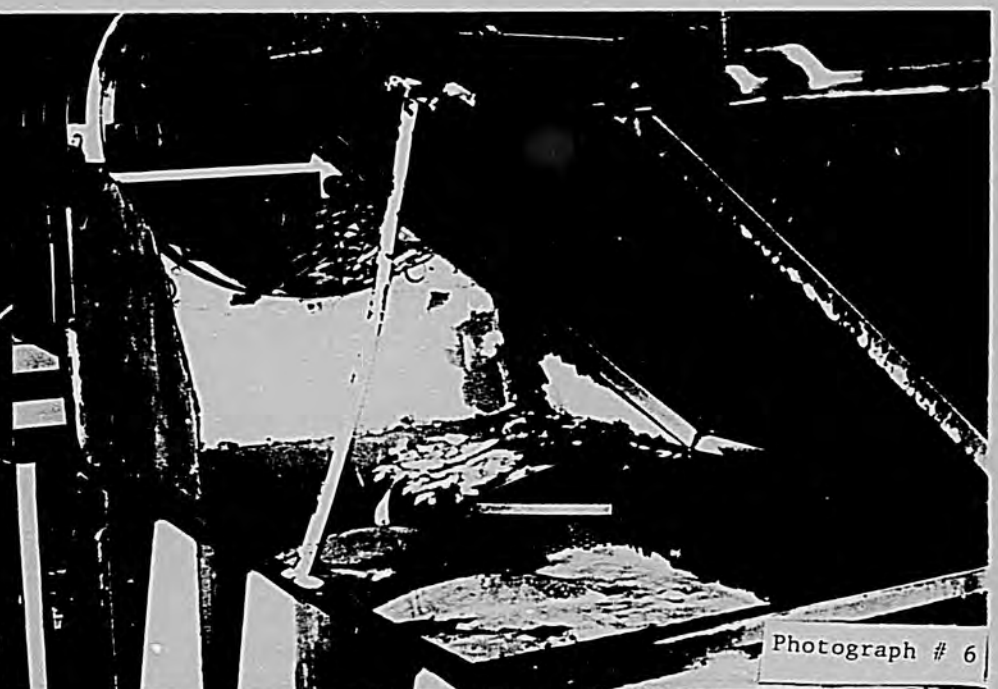
Photograph # 1

Photograph # 2

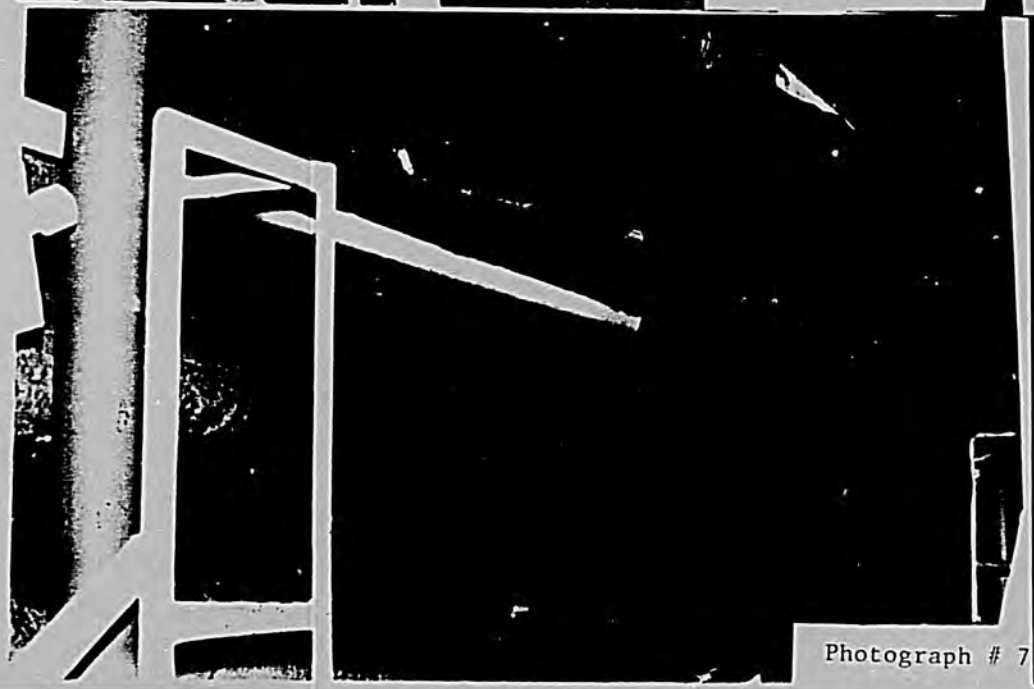
Photograph # 3

Photograph # 4

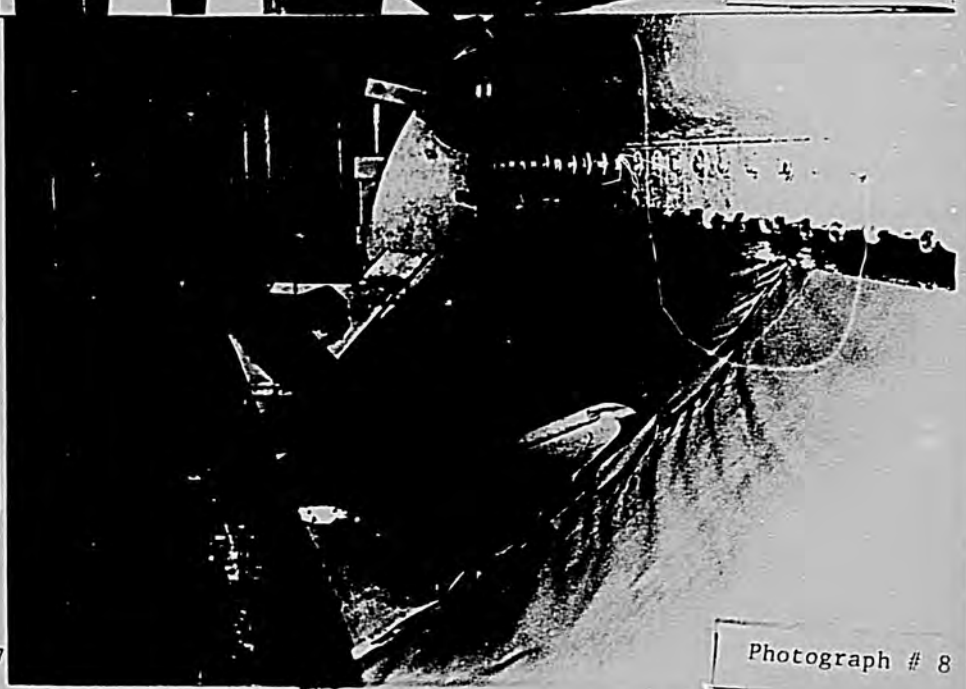
Photograph # 5



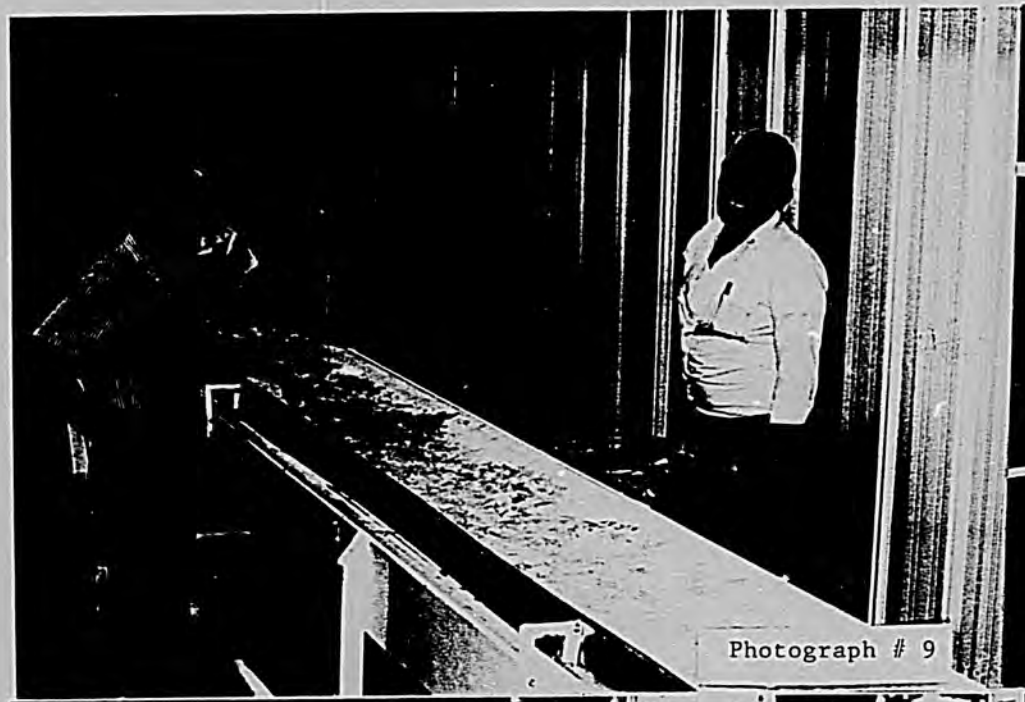
Photograph # 6



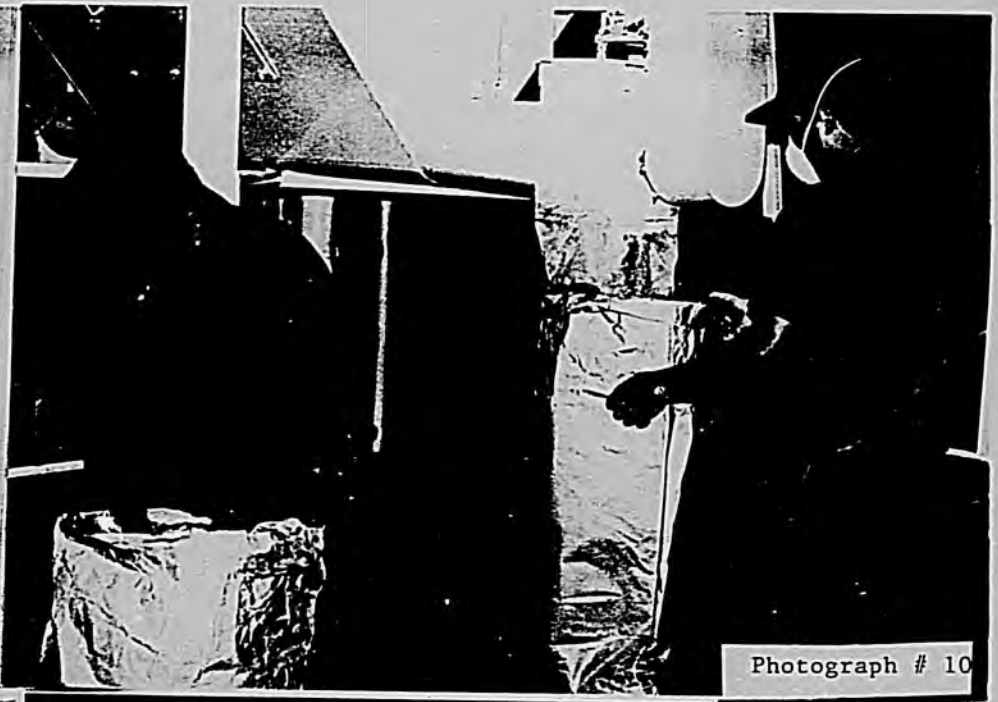
Photograph # 7



Photograph # 8



Photograph # 9



Photograph # 10

Photograph # 11

Photograph # 12

15

Project Outline

"Stability of Provitamin A Carotene in Fortified Dried Sweet Potatoes"

Steven J. Schwartz, Ph.D.
Professor
North Carolina State University
Raleigh, NC 27695-7624

Objectives:

1) Determine the stability of provitamin A carotene of dried sweet potatoes during storage in various packaging materials and atmospheres.

2) Evaluate the influence of antioxidant (BHT, vitamin E) and metal ion nutrients (zinc, iron) on the stability of provitamin A carotene during storage.

Research Plan:

Drum dried sweet potato flakes will be delivered from Guatemala to North Carolina State University, Raleigh, NC. Upon receipt, the product will be ground into a powder and sub-samples prepared containing antioxidants and metals. The additives will be uniformly dispersed into the dried material using a Hobart feed mixer. The following levels of additives will be used:

BHT	.1% of lipid content, ~ 2 ug/g
Vit E	2.5 mg/30 g buds
Zinc	2.5 mg/30 g buds
Iron	2.5 mg/30 g buds

Table 1 illustrates the various combinations of additives to be tested throughout this study. In addition, four different packaging types/atmospheres will be tested to determine optimal packaging conditions for preservation of provitamin A nutrients. As follows:

Package A.	Gas permeable wrap
Package B.	Foil impermeable with air headspace
Package C.	Foil impermeable with "ageless" (oxygen scavenger added)
Package D.	Foil impermeable under vacuum.

Samples in sub-sets will be extracted and analyzed for provitamin A nutrients at various time intervals (Table 2) up to a six month storage period. All packages will be stored under ambient conditions until analyzed.

HPLC Analysis:

Extraction and HPLC analysis will be conducted as previously described for sweet potato buds.

Table 1. Plan for packaging of sweet potato buds.

Packaging A	#	Packaging B	#	Packaging C	#	Packaging D	#
sample	12	sample	9	sample	9	sample	9
sample with antioxidants	12	sample with antioxidants	9	sample with antioxidants	9	sample with antioxidants	9
sample with metals	12	sample with metals	9	sample with metals	9	sample with metals	9
sample with all variables	12	sample with all variables	9	sample with all variables	9	sample with all variables	9
sample with Zn	3			sample with Zn	3		
sample with BHT	3			sample with BHT	3		
sample with E	3			sample with E	3		
sample with Fe	3			sample with Fe	3		
Total Number of Package A	60	Total Number of Package B	36	Total Number of Package C	48	Total Number of Package D	36

Note: Packaging A is atmosphere permeable, packagings B, C and D are impermeable..
Packing B has an air headspace, C has an atmospheric control agent (ageless) and D is under vacuum.
All Packages will need to hold approximately 50 grams of product.

Table 2. Time Plan For Analysis.

Packaging A	Time 0	Time 1	Time 2	Time 4	Total Analysis	Total Packages	Packaging B	Time 0	Time 1	Time 2	Time 4	Analysis	Total Pks.
sample	1	1	1	1	4	12	sample	0	1	1	1	3	9
antioxidants	1	1	1	1	4	12	antioxidants	0	1	1	1	3	9
metals	1	1	1	1	4	12	metals	0	1	1	1	3	9
all variables	1	1	1	1	4	12	all variables	0	1	1	1	3	9
Zn				1	1	3							
BHT				1	1	3							
E				1	1	3							
Fe				1	1	3							
Total # A	4	4	4	8	20	60	Total# B	0	4	4	4	12	36

Packaging C	Time 0	Time 1	Time 2	Time 4	Total Analysis	Total Packages	Packaging D	Time 4	Analysis	Total Pks.
sample	0	0	1	1	2	9	sample	1	1	9
antioxidants	0	0	1	1	2	9	antioxidants	1	1	9
metals	0	0	1	1	2	9	metals	1	1	9
all variables	0	0	1	1	2	9	all variables	1	1	9
Zn	0	0	0	1	1	3				
BHT	0	0	0	1	1	3				
E	0	0	0	1	1	3				
Fe	0	0	0	1	1	3				
Total # C	0	0	4	8	12	48	Total #D	4	4	36

Note Packaging A is atmosphere permeable, packagings B, C and D are impermeable with B having an air headspace.
C packaged with an atmospheric agent (ageless) and D packaged under vacuum.
All Packages will need to hold approximately 50 grams of product.

TELEFAX
North Carolina State University

Date :August 12, 1993

Total number of pages (including this cover sheet) : 1

From: Steven J. Schwartz, Professor
Department of Food Science
North Carolina State University
Box 7624, Raleigh, NC 27695-7624
(919) 515-2959 (voice)
(919) 515-7124 (Fax)

To : Dr. John Barrows
Company Name : IEF - Bethesda
Fax Number : 301 986-1876

Message:

Thanks for the information on the IVACG meeting in Tanzania and for the copy of the extended abstract.

Regarding the results thus far for the analysis:

Upon arrival of the buds, minerals (Zn & Fe) and antioxidants (BHT & Vit E) were added. We have packaged the Buds at Cryovac Corp., Greenville, SC using four different package environments (oxygen permeable, barrier pack with air, barrier pack with air and oxygen scavenger, barrier pack with vacuum).

Fresh sweet potatoes were analyzed upon arrival. These analyses indicated a carotene level (16.5 ug/ g fresh wt.) which ranked most closely to the "low" sweet potato group prevously analyzed. The Buds analyzed in March, 1992 were higher in carotene levels.

Results for the Buds:	*July, 1993*	*42.2 ug/g Bud*
	March 1992	*57.5 ug/g Bud*

Vitamin E was measured by HPLC in all samples mixed. Concentrations measured indicated that uniform amounts were distributed throughout those samples spiked. Thus our technique to add the vitamin, although in an oil state, worked well. Also, significant levels of native Vit E were determined in the buds. Fe & Zn analyses are currently underway.

Time zero measurements for carotene in all the samples have been completed. Time 1 measurements will begin in two weeks. At that time, we will begin to learn more about the effect of the package as influenced by additive (minerals & antioxidants) during storage.

If you need details and more data, let me know and we will send a preliminary report.

Best Regards,

Steve

FILE

19

Analysis of β-Carotene Content in Guatemalan Sweet Potato Buds

Preliminary Report to International Eye Foundation
Bethesda, MD

September 1993

Prepared by:
Ruth H. Watkins, Nada Simunovic, and Steven J. Schwartz
North Carolina State University

Introduction:

Sweet potatoes were grown in Guatemala and processed into buds. The buds are being developed into an instant cereal product targeted at Guatemalan children. The buds are a potential source of affordable provitamin A. The provitamin A compound in sweet potatoes is β-carotene. The objectives of this experiment were: to find the β-carotene content of these samples, convert β-carotene values into retinol equivalents (RE) and to compare the effect of packaging types, additives and length of storage on the β-carotene content.

Experimental:

Sweet potatoes were harvested and processed into buds in Guatemala. Samples from CeSSIAM of sweet potatoes buds were flown to North Carolina State University (Raleigh, NC) and stored for 6 days at -20 °C prior to further processing and packaging. The total time from harvest through packaging was 9 days.

Processing and addition of additives:

Once packaging was arranged, buds were allowed to thaw at room temperature. The buds were divided into groups for the addition of additives. Vitamin E, iron (reduced) and zinc (as zinc oxide) were added in a concentration of 2.5 mg per 30 grams of buds. (It was assumed that 30 grams was a standard serving size.) BHT (butylated hydroxytoluene) was added in a concentration of 3.6 μg per gram of buds (0.02% of the estimated fat content).

Eight mixes were prepared:

1) no additives (control),
2) vitamin E,
3) BHT,
4) vitamin E and BHT (antioxidants),
5) iron,
6) Zinc,
7) iron and zinc (metals)
8) vitamin E, BHT, iron and zinc (all variables)

A Hobart feed mixer was used to disperse the additives and grind the buds into a homogeneous mixture. Mixing time for all eight composites was 30 minutes. Samples were weighed into 50 gram portions and transported to Cyrovac, Duncan SC for packaging.

Packaging:

The four package types that were used are:

1) atmosphere permeable (A),
2) atmosphere impermeable packed with air headspace (B),
3) atmosphere impermeable packed with an oxygen scavenger, ageless®, (C)
4) atmosphere impermeable packed under vacuum (D).

The number of samples packaged under each type of condition varied according to the packaging scheme in Table 1. The number of packages that are necessary for each package type vary due to the sampling regime as shown in Table 2. The samples were stored in the dark until needed for extraction. Duplicate extractions of each sample were performed.

Extraction and HPLC procedures:

Thirty grams of buds, 130 mL of water and 3 grams of calcium carbonate were blended to make a puree. 20 grams of this puree was used for extraction. The remaining extraction procedure and HPLC analysis followed previously described methods for carotenoids. Vitamin E extraction was performed and analyzed by HPLC for quantitation. The extraction procedures and HPLC conditions were similar to those used for the carotenoid work. However, vitamin E was quantitated at 292 nm.

Zinc and iron quantitation was performed by the Soil Science Dept. (NCSU) using a Perkin Elmer ICP instrument Model Plasma II for inductively coupled plasma emission spectrophotometry.

Results and Discussion:

The provitamin A carotenoid, β-carotene, is found in abundance in sweet potatoes. The all-trans form of β-carotene predominates in the

bud samples. However, during the thermal process for producing buds, significant quantities of the cis isomers were formed. This isomeric change does not affect the calculation for provitamin A activity. However, studies have shown that isomerization of the all-trans to the cis isomers reduces the biological availability of β-carotene as a precursor to vitamin A (Zechmeister, 1949 and Sweeny and Marsh, 1971).

A comparison of the sweet potato and the average bud samples from March 1992 and July 1993 is shown in Table 3. Buds from 1992 were higher in β-carotene content than the 1993 samples. The fresh (raw) potato of 1993 had a β-carotene content that was in between the amounts of the blanched 1992 pale samples (improved variety intense orange color produced by ICTA in La Fragua, Zacapa) and the less pale samples (variety purple peel and yellow pulp from San Miguel Duenas, Sacatepequez, Antigua).

The average concentration of β-carotene and RE (retinol equivalent) value of the buds at time 0 and one mouth are shown in Table 4. (As in previous studies, the moisture content of the buds was assumed to be 0% and the values reported in Table 4 are for dry weight.) As expected the carotene is degrading as storage time increases. No clear trend has developed in relation to the additives, although the sample that contains all variables does appear to have a slightly higher carotene content.

Tests for the dispersion of the additives show that the mixtures all contained approximately the same amount of their respective additive. Values for the total iron content (in the iron additive samples) show that some of the added iron was not incorporated into the mixes. Also, the iron distribution was less homogeneous than for the other additives. However, the zinc distribution and incorporation into the mixtures was good. Naturally occurring levels of zinc and iron in the buds were approximately 4 ppm (parts per million) and 20 ppm respectively.

In summary, the variety of sweet potato used to produce the buds had a RE content that was somewhat lower than in the typical American variety (5.3 RE as compared to 8.8 RE (Adams, 1975)). The method of packaging and addition of additives appears to be adequate for this study. The effect of the additives on the degradation rate of the carotene content has yet to be fully evaluated.

References

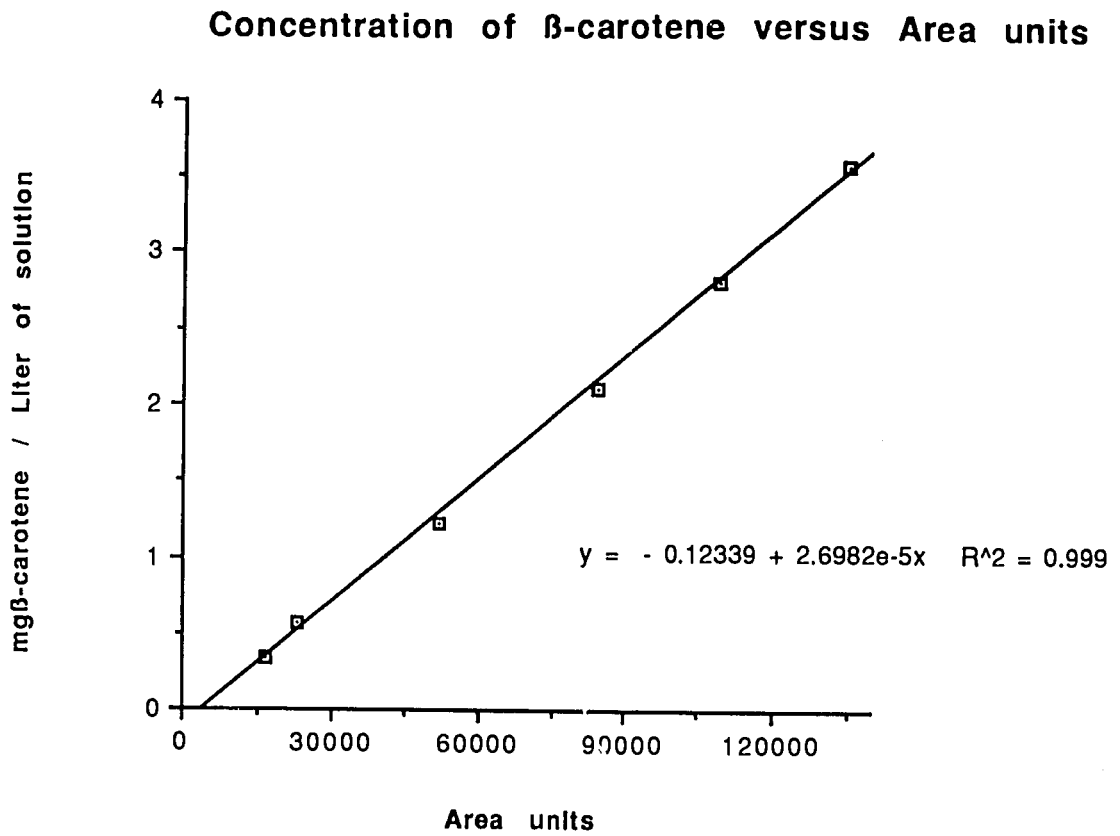
Adams, C.A. 1975. "Nutritive Value of American Foods". Ag. Handbook No. 456. US Printing Office, Washington, DC.

Sweeny, J.P. and Marsh, A.C. 1971. Effect of Processing on Provitamin A in Vegetables. J. A. Diet. Assoc. 59:238-243.

Zechmeister, L. 1949. Stereoisomeric Provitamins A. Vitamin. Horm. 7:57-81.

Appendix

1- Concentration curve for β-carotene versus absorbance units
2- Sample calculations for conversion of absorbance unit to RE


Concentration of ß-carotene versus Area units
mgß-carotene / Liter of solution
4
3
2
1
0
0
30000
60000
90000
120000
Area units
y = - 0.12339 + 2.6982e-5x R^2 = 0.999

Conversion of β-Carotene to Retinol Equivalents:

Sample calculation: y= concentration of ß-carotene (mg/L)

x= area units from the dynamax integration

$y=-0.12339*10^{-1} + 2.6982*10^{-5}$ (x)

mg/L to μg/g sample used 50 mL total sample extraction volume.

1 Retinol Equivalent= 6 μg β-carotene

Table 1. Plan for packaging sweet potato buds.

Additive	Packages of A[1]	Packages of B[2]	Packages of C[3]	Packages of D[4]
Control	12	9	9	9
Antioxidants	12	9	9	9
Metals	12	9	9	9
All variables	12	9	9	9
Zinc	3	0	3	0
Iron	3	0	3	0
BHT	3	0	3	0
Vitamin E	3	0	3	0

Note: 1- Package A is oxygen/atmosphere permeable.
2- Package B is oxygen/atmosphere impermeable and has an air headspace.
3- Package C is oxygen/atmosphere impermeable and has an oxygen scavenger included (ageless®).
4- Package D is oxygen/atmosphere impermeable and is under vacuum.

Table 2. Sweet potato bud analytical sampling plan.

Additive	Time 0	1 month	2 months	4 months
Control	A	A, B	A, B, C	A, B, C, D
Antioxidants	A	A, B	A, B, C	A, B, C, D
Metals	A	A, B	A, B, C	A, B, C, D
All variables	A	A, B	A, B, C	A, B, C, D
Zinc	-	-	-	A, C
Iron	-	-	-	A, C
BHT	-	-	-	A, C
Vitamin E	-	-	-	A, C

Table 3. Comparison of RE value and β-carotene content in sweet potatoes and buds from two years.

Year	μg β-carotene per g Bud	RE per g Bud	μg β-carotene[1] per g potato (dry wt.)	RE[1] per g potato (dry wt.)
1992	57.5 +/- 4.1	9.6 +/- 0.7	29.1 +/- 12.1	4.8 +/- 2
			12.9 +/- 0.1	2.1 +/- 0
			1139.0 +/- 236.5	189.8 +/- 39.4
1993	42.2 +/- 1.3	7.0 +/- 0.2	16.5 +/- 1.7	2.8 +/- 0.3

Note: 1. Potatoes from 1992 were blanched, while potatoes from 1993 were fresh (raw).

Table 4. Average β-carotene content and RE value of sweet potato buds.

Sample Name	Package	(μg β-carotene)/(g bud)	(RE)/(g bud)
Time 0			
Control	A	42.2 +/- 1.3	7.0 +/- 0.2
Metals	A	40.8 +/- 2.2	6.8 +/- 0.4
Antioxidants	A	42.6 +/- 0.3	7.1 +/- 0.1
All variables	A	42.8 +/- 0.5	7.1 +/- 0.1
Time 1 Month			
Control	A	33.7 +/- 0.9	5.6 +/- 01
Metals	A	33.6 +/- 0.4	5.6 +/- 0.1
Antioxidants	A	33.4 +/- 0.2	5.6 +/- 0.0
All variables	A	36.0 +/- 0.8	60. +/- 0.1
Control	B	33.8 +/- 0.4	5.6 +/- 0.1
Metals	B	35.8 +/- 0.7	6.0 +/- 0.1
Antioxidants	B	35.7 +/- 0.2	6.0 +/- 0.0
All variables	B	35.4 +/- 0.4	5.9 +/- 0.1

INFORME TRIMESTRAL, CAMOTE 2

- Durante el mes de junio se realizaron visitas a comunidades, seleccionando las que participarian en el estudio.

- Cuando ya se tuvieron las comunidades seleccionadas, se procedio de la manera siguiente:
  1) se establecieron contactos con las escuelas y Organizaciones no Gubernamentales que funcionan en cada una de las comunidades. Estas reunieron grupos de personas, en su mayoria madres de familia; habiondo sido informadas por miembros del "Proyecto Camote 2", sobre el contenido -- del mismo.

  2) Se delimitaron areas para censo

  3) Se estructuro e imprimieron boletas para censo.

  4) Se asigno a cada comunidad su respectivo modelo o forma de distribu-- cion, quedando como sigue:

No.	NOMBRE	AREA	FORMA
1	La Libertad	Sacatepequez	Regalado sin limite
2	Santa Isabel	Sacatepequez	Regalado con limite (1 libra X niño)
3)	Lo de Rodriguez	Zona 18	vendido al 50 % (Q.2.00)
4)	Santa Barbara	Zona 18	vendido al 100 % (Q.4.00)

- Del 25 de junio al 15 de julio se realizo censo y mapeo simultaneamente en las cuatro comunidades, en el orden siguiente:
  4) Santa Barbara, censando 58 familias con niños menores de 6 anos; incluyendo el sector 4, parte del 5 y algunas del sector 1, 2,y 3.

  3) Lo de Rodriguez, se censaron 60 familias
  2) Santa Isabel " 32 "
  1) La Libertad " 41 "

- En la segunda quincena de julio se introdujeron los datos del censo en la computadora, ademas de visitaron las cuatro comunidades para seleccionar posibles centros de distribucion y bodega de almacenaje.

- Del 2 al 4 de agosto, contacto con nuevos lugares para bodega y distribucion, pues varios de los contactados antes, respondieron que no aceptaban. Quedando finalmente 3 centros de distribucion en cada una de las comunidades de la zona 18 y una bodega en cada una.

- En las comunidades de Sacatepequez, en la misma bodrga se distribuye el producto. Esta actividad esta a cargo de dos personas miembros del Proyecto.

- El 5 de agosto se recibio en la Malher 70 sacos de hojuelas de camote, conteniendo 35 libras cada uno, de los cuales se dejaron: 35 sacos en cada una de las comunidades de la zona 18.

- 6 de agosto se inicio la distribucion en Santa Barbara.

- 9 de agosto se inicio la distribucion en Lo de Rodriguez.

- Todos los sacos fueron numerados antes de ser entregados en las comunidades, para facilitar su control.

- A partir del 10 de agosto se visita un dia a cada comunidad:
  lunes, Santa Bárbara
  martes, Santa Isabel
  miércoles, Lo de Rodriguez
  jueves, La libertad
  viernes, reuniones para informes en Comite Pro-Ciegos.

ORGANIZACION EN CADA COMUNIDAD

+ Los dias lunes en Santa Bárbara, se han efectuado dos formas de motivacion:
  1) invitar a madres de familia, para que asistan por las tardes a observar algunas formas de preparacion de las hojuelas de camote.

  2) visitas a domicilio mostrando el producto y explicando formas de preparacion.

- Los dias miercoles en Lo de Rodriguez, se invita a madres de familia para que asistan por las tardes a observar algunas formas de preparacion.. Proximamente se haran visitas a domicilio como en Santa Barbara.

- En las dos comunidades de Sacatepéquez, mientras se distribuye el producto se invita a las madres para que asistan por la tarde a observar formas de preparacion.

OBSERVACIONES:

En las comunidades de Sacatepequez se distribuye un promedio de 70 libras cada dia de distribucion.

En Lo de Rodriguez hasta el 15 de septiembre se habian vendido dos sacos (70 libras) en dos centros de distribucion. Estando otros 3 sacos ya iniciados.

En Santa Barbara la venta es casi inexistente, hasta el 15 de septiembre se habian vendido 22 libras entre los 3 centros de distribucion.

Atol

RECETAS DE HOJUELAS DE CAMOTE

INGREDIENTES:

5 Vasos de Agua o leche
1 1/2 vaso de camote
6 cucharadas de azúcar.
1 rajita de canela
1 pizca de sal

PPREPARACION:

1) Se pone a hervir 3 vasos de agua con canela y la sal.
2) Se deshace el camote agregando poco a poco el resto de agua.
3) Se deja caer en el agua hirviendo.
4) Se deja hervir por 3 minutos.

PURE DE CAMOTE

11/2 Vaso de agua o leche
1 vaso de camote
6 Cucharadas de azúcar
1/2 Cucharadita de polvo de canela
6 Cucharadas de azúcar y
6 Cucharadas de agua para miel.

PREPARACION:

1) Se mezcla bien todas los ingredientes.
2) Se pone a calentar aceite en un sartén.
3) Se va dejando caer la mezcla, extendiendola un poco con la espátula.
4) Se cocina a fuego lento.

BOCADO DE REINA

INGREIDENTES:

1 LIbra de harina de pan
1 Libra de Hojuelas de Camote
3 Barras de Margarina
4 Huevos
Azúcar al gusto (1/2 libra)
1 Cucharadita de royal.

PREPARACION:

1) Se amaza bien todo, se pone en un molde harinado y luego se pone en el rescoldo (donde se torteó) sacando las brazas y poniendolas sobre el comal.
2) Se cocina por 3 o 4 horas.

PANES

INGREDIENTES:

1 Vaso de Camote
1/2 Vaso de Agua
1/3 Vaso de Azúcar
1/2 Cucharadita de Royal
1 Huevo
1/2 Barra de margarina derretida

PREPARACION:

Se amaza todo, se hacen tortitas y se les rosea harina para que no se pegue.
Se ponen en el sartén con aceite caliente.

SOPA

INGREDIENTES:

1 Tomate mediano
1 Cebolla mediana
1 Vaso de agua
1/2 Vaso de Camote
1 Cucharada de Consomé
1 Rama de Cilantro
1 Onza de margarina
1 Pizca de Sal

PREPARACION:

1) Se pica bien la cebolla y el tomate, se ponen a freir con la margarina.
2) Se deshace en el agua el camote y se deja caer en el tomate frito.
3) Se agrega el consomé, la sal y el cilantro.
4) Si se tiene, se le puede agregar papa, zanahoria o guisquil en trozos.

PAN CAKE

INGREDIENTES:

11/4 Vaso de agua o leche
1 Vaso de camote
1 Huevo
2 Cucharadas de aceite o margarina

PREPARACION:

1) Se mezcla bien todo, se pone un sartén al fuego y se deja caer la mezcla por pocos, extendiendola un poco con la espátula.
2) Se cocina a fuego lento.

Se sirven con miel o jalea.

Guatemala, 20 de Septiembre de 1,993.

REPORTE SPB II

Héctor Gamero y Carlos Valdez
meses: Julio Agosto y Septiembre

ACTIVIDADES:

A. Contactos:

Se visitaron las cuatro comunidades en busca de las autoridades locales y/o contactos necesarios para poder iniciar nuestras actividades de campo; los contactos realizados se detallan a continuación:

1.- Comunidad "Santa Bárbara": en esta comunidad los contactos se hicieron a través de la directora de la Escuela de Educación Primaria y de personal de una Organización No Gubernamental (ONG), llamada Alianza para el Progreso. Estas personas se encargaron de informar a la comunidad de nuestra presencia y motivo de trabajo, por medio de reuniones con la comunidad y repartiendo volantes.

2.- Comunidad "Lo de Rodriguez": en esta comunidad los contactos fueron hechos con la directora de la Escuela de Educación Primaria y una ONG llamada Visión Mundial. El mecanismo usado fué similar al de la comunidad anterior.

3.- Comunidad "La Libertad": los contactos realizados en esta comunidad se hicieron a través de la Escuela de Educación Primaria y con personal voluntario que trabaja con la Asociación Pro-Bienestar de la Familia (APROFAM).

4.- Comunidad "Santa Isabel": en esta comunidad el contacto se hizo por medio del Puesto de Salud local, con la colaboración de la enfermera de dicho puesto. Con esta persona se hizo una visita inicial de reconocimiento para conocer el area fisica y platicar con algunas personas de la comunidad.

B. Preparación del material de trabajo:

Este trabajo consistió en la reproducción y adaptación de los dos instrumentos a utilizar para la recolección de datos: a) recoradtorio de consumo de alimentos de 24 horas y b) cuestionario de frecuencia en el consumo de alimentos ricos en vitamina A. Al mismo tiempo, se procedió a la búsqueda de los modelos de utencilios para registrar lo mas exactamente posible, las cantidades de alimentos consumidaos por las familias. Durante esta etapa del trabajo, se realizaron los censos de las cuatro comunidades y se hicieron los croquis respectivos.

C. Estandarización en Area de Campo

Como paso previo al trabajo definitivo de recolección de datos, el primer dia se hizo una breve estandarización en la primera comunidad, con la finalidad de detectar algunos problemas propios del proceso en el campo. En base a los resultados obtenidos, se replanteó la metodologia definitiva y se dió inicio al trabajo de recolección de datos.

D. Recolección de datos de campo:

El trabajo dió inicio el dia 6 de Julio del presente año en la comunidad de "Santa Bárbara", llevándola en forma secuencial en las otras tres comunidades. Este trabajo consistió en visitas domiciliarias a cada uno de lo hogares previamente seleccionados, para realizar entrevistas personales con la persona encargada de la alimentación de los preescolares: generalmente, fueron las madres de familia quienes proporcionaron la información solicitada. Dicha información fué registrada en los instrumentos de campo, en el preciso instante de su obtención. El trabajo de recolección de datos finalizó el dia 12 de Agosto del presente año.

E. Revisión, organización y codificación de la información recolectada:

En base a la estructura organisativa de los censos de las cuatro comunidades, se procedió a organizar y codificar todas las encuestas usadas en cada familia entrevistada. Este fué un proceso detallado, que requirió de la revisión de toda la información obtenida durante el trabajo de campo.

F. Creación de los archivos de datos:

Los datos del cuestionario de frecuencia de consumo de alimentos ricos en vitamina A, fueron ingresados a una estructura previamente elaborada, con el objeto de facilitar su conversión a gramos. Este proceso requirió de la participación de las personas del equipo de trabajo de campo y de la persona designada para dar apoyo en el proceso de elaboración de los archivos. Actualmente se cuenta con este archivo finalizado.

G. Inicio de la segunda fase de recolección de datos:

Para dar inicio a esta segunda fase, se coordinó con el equipo engargado de la comercialización del producto el inicio de la misma y se decidió empezar esta fase el dia 6 de Septiembre del presente año, fecha en que se cumplia exactamente un mes de haber iniciado dicha comercialización. Actualmente estamos en esta fase, esperando terminar a finales del presente mes de Septiembre.

[illegible] DE ALIMENTOS RICOS EN VITAMINA "A"

Appendix 7

NOMBRE: 100
SEXO: F M
EDAD:
PROCEDENCIA: Fotocopias

FECHA:
ENTREVISTADOR:
TIEMPO:

ALIMENTO	PORCION	7 DIAS	ER
¿Come vísceras, huevos o carnes? Si No			
Hígado de res	1 oz.		
Carne de cangrejo	1 oz.		
Sesos de res	1 oz.		
Panza de res	1 oz.		
Pulmón de res (bofe)	1 oz.		
Salchicha	1 u.		
Huevo de gallina	1 u.		
Otros:			
¿Toma leche? Si No			
¿Come queso, mantequilla o crema? Si No			
Leche fluída de vaca (int.)	1 tz.		
Leche íntegra en polvo	1 cda.		
Queso duro de leche íntegra (seco)	1 oz.		
Queso blando de leche (fresco)	1 oz.		
Crema espesa	1 cda.		
Crema rala	1 cda.		
Mantequilla con sal	1/2oz.		
Margarina	1/2oz.		
Otros:			
¿Toma Incaparina? Si No			
Incaparina	1 cda.		
¿Come verduras o hierbas? Si No			
Zanahoria	1 u.		
Chipilín	1/2tz.		
Quilete, macuy o hierbamora	1/2tz.		
Camote	1/4u.		
Bledo	1/2tz.		
Espinaca	1/2tz.		
Berro	1/2tz.		
Güicoy sazón	1/2tz.		
Acelga	1/2tz.		
Puntas y hojas de güisquil	1/2tz.		
Cebollino(cebollitas)	1/2tz.		
Chile pimiento fresco	1/2tz.		
Lechuga no arrepollada(del país)	1/2tz.		
Tomate maduro	1 u.		
Arvejas	1 cda.		
Otros:			
¿Come frutas? Si No			
Mango maduro	1 u.		
Plátano maduro	1/4u.		
Melón	1rodaja		
Mandarina reina(tipogrande)	1/4u.		
Marañón	1 u.		
Zapote	1/4 u.		
Papaya Madura	1rodaja		
[illegible]	[illegible]		

BEST AVAILABLE COPY

Fecha _____ Aldea: ___ Familia: _____ No. miembros: _____ Codigo niño: __ Nombre niño: _____

Nombre del niño: _____

Nombre de informante (relación) _____ (_____ _____)

1) NOMBRE DE LAS PREPARACIONES	2) ALIMENTOS USADOS		5) Origen	6) CONSUMO DE LA FAMILIA					10) CONSUMO DEL NIÑO			
	3) Cod	4) Nombre, precio		7) Cantidad: peso, unidad, volumen, precio			8) Porciones	9) Gramos	11) Cantidad: peso, unidad, volumen, porciones			12) Gramos
				Preparado	No consume	Consume			Servida	Sobrante	Consumida	

BEST AVAILABLE COPY